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Five hundred and fiftieth Meeting.

April 11, 1865. — MONTHLY MEETING.

The PRESIDENT in the chair.

Mr. Alexander Agassiz read a paper on the young of a species of *Planaria.*

Five hundred and fifty-first Meeting.

April 25, 1865. — SPECIAL MEETING.

The PRESIDENT in the chair.

Professor Lovering presented a report from the Rumford Committee, recommending that the Rumford Premium be awarded to Professor Daniel Treadwell for improvements in the management of heat, and the subject of the report was assigned as the special business of the meeting on the second Tuesday of May.

Professor Cooke made the following communication: —

An accident to one of the large turbine wheels employed by the Merrimack Manufacturing Corporation of Lowell has furnished a most remarkable illustration of the modern mechanical theory of heat, and through the kindness of Mr. Isaac Hinckley, the accomplished agent of the Corporation, I have the pleasure of bringing the facts to the notice of the Academy. I cannot do better than to begin by reading Mr. Hinckley's own statement, in a letter addressed to me, dated December 30th, 1864. The specimens referred to in the letter I have placed on the table for the inspection of the Academy.

"In accordance with your request, I herewith send you five pieces of metal, once portions of one of our turbines. I have placed these pieces in the box in the same relative positions which they occupied when they made a part of the turbine. To make my statement clear to you, I would refer to Plate I. of Mr. Francis's admirable work, 'Lowell Hydraulic Experiments,' which you will find in the College Library. Our turbines are similar to the Tremont turbine therein shown.

"The turbine of which these pieces were a part is one of 250 H. P., under a fall of 32 feet, using 75 cub. ft. of water per second. The wheel is of 58½ inches diameter, with depth of float of 6 inches, and a velocity of 144 revolutions per minute. Its position is horizontal, and at a level of 3 feet below the surface of Merrimack River at its ordinary stage. It is mounted upon a vertical wrought-iron shaft 25 feet long and 6 inches diameter at smallest place. This shaft is fitted at its upper end with a series of disks, by means of which it is supported in its box, which again is supported by a massive cast-iron frame. This frame supports the entire weight of the wheel and shaft. The shaft at its lower end is bored in the line of its axis to a depth of 5½ inches to receive a steel pin of 17½ inches length and 2½ inches diameter; and which projects from the shaft 12 inches. The steady-pin has no function to perform other than that of restraining the shaft from lateral aberration. It is free to revolve in a box made of three pieces of case-hardened iron, so placed in a cast-iron frame as to allow free play to the steady-pin and the free access of water to it. Each of these three pieces composing this box is kept up to its place by following-screws working in the cast-iron frame which is bolted to the stone floor of the turbine pit. In the Tremont turbine this floor is of wood, and in Plate I. the steady-pin is marked 'I.'

"The pieces sent are marked Nos. 1 to 5. No. 1 is the portion of the steady-pin which was nearest the shaft; No. 2, the other extremity of the same pin; Nos. 3, 4, 5, the three pieces of case-hardened iron forming the box, with portions of the steady-pin attached. You will at once perceive that this steel has been partially fused, and can thus account for its attachment to the iron.

"The facts are, that on noticing some irregularities of motion on the part of the wheel, it was stopped, and the water pumped from the pit until the floor was bare. Inspection showed that the following-screws had not done their duty uniformly; and the three pieces, Nos. 3, 4, 5, no longer preserved their proper relative positions, nor allowed free play to the steady-pin. The consequence was, an amount of friction causing heat sufficient to fuse steel, although the latter was immersed three feet deep in a raceway ten feet wide, through which was passing seventy-five cubic feet of water per second.

"A similar accident happened thrice to our turbines, which are now, however, safely guarded against such mishaps."

There are two points in connection with these facts to which I wish especially to call attention. In the first place, the weight of the wheel did not rest upon the surfaces of friction. The three pieces of case-hardened iron in their displaced position acted simply as a brake upon the revolving shaft, so that the heat must have resulted wholly from the destruction of mechanical motion. The immense moving power of the wheel, instead of being directed wholly into its appropriate channel, was in part transformed into that mode of atomic motion called heat. In the second place, the temperature attained was at least the welding-point of iron, and this, too, although the heated metal was immersed in a stream of flowing water. It is undoubtedly true, that the sphèroidal condition of the water would greatly retard the loss of heat, but still the loss must have been exceedingly rapid. Now the loss, even at the highest temperature attained, must have been fully supplied by the heat generated during the same time; and this must, therefore, have been evolved with equal rapidity at the surfaces of friction. No change in the molecular condition of the iron, and no abrasion of the metal, is at all sufficient to account for this continuous, prolonged, and immensely rapid evolution of heat, and the facts force upon us the conclusion, that the destruction of mechanical motion is the one and only efficient cause. Moreover, if we admit the generally received principle of mechanics, that motion cannot be annihilated, the conclusion that heat is a mode of motion is equally irresistible. Lastly, it is evident that the facts here stated perfectly accord with the well-known experiments of Rumford and Davy; only since the moving power of the Merrimack turbine is so much greater than that employed by these distinguished experimentalists, the results which I have had the pleasure of exhibiting are more striking and conclusive than any which have been previously obtained.

Five hundred and fifty-second Meeting.

May 9, 1865. — MONTHLY MEETING.

The PRESIDENT in the chair.

The Recording Secretary read letters relative to exchanges.

The proposition of the Rumford Committee, that the Rumford Premium be awarded to Professor Treadwell for his improvements in the management of heat, which had been referred to this meeting, was then brought up for discussion, and was referred to the Annual Meeting for the action of the Academy.